5th Integrated CNS Conference & Workshop

Communications-Supported Concepts for Highjacked Aircraft

Tom Mulkerin

May 3, 2005

7405 Alban Station Ct., Suite B-201, Springfield, VA, 22150-2318, (703) 644-5660

Outline

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Background

- **Aviation security emphasis changed dramatically after September 11, 2001**
  - **Context of threat has changed**
  - **Aircraft can be used as a weapon**
  - **Passengers became obstacles**
- **Additional tools needed to deal with highjacking**
  - **Increased emphasis on early detection of hostile takeover**
  - **Learn more about the highjackers and their intentions**

Focus & Concepts

- **Focus: Communications support for monitoring and reacting to activities on a highjacked commercial aircraft**
- **Concepts discussed**
  - **Panic button to alert the ATC system, TSA and airline**
  - **Aircraft video and audio on demand to observe what is occurring on the aircraft**
  - **Automatic flight plan transmission to alert hijack response team of change in intended flight path**
- **Implementation**
  - **Development of new equipment not required**
  - **New applications for existing equipment**
  - **Resulting in early implementation**

Scenario

- **ACME Air flight 123 en route from Boston to Atlanta**
  - **15 minutes after departure, hijackers break into cockpit**
  - **Pilot actuates panic button**
    - **ACARS message sent to FAA's ATCSCC**
    - **Synthesized voice message sent over current VHF voice radio**
    - **Digital Flight Data Recorder records transactions**
    - **DFDR starts to record all video/audio inputs from onboard cameras**
- **ATCSCC Flight Data Processor (FDP) receives message**
  - **Display changed to notify ATCSCC watch personnel**
  - **FDP forwards message to TSA, ACME's AOC, and ARTCC responsible for aircraft**
- **ATCSCC, TSA, ARTCC and AOC response team coordinate actions over landline voice circuit**

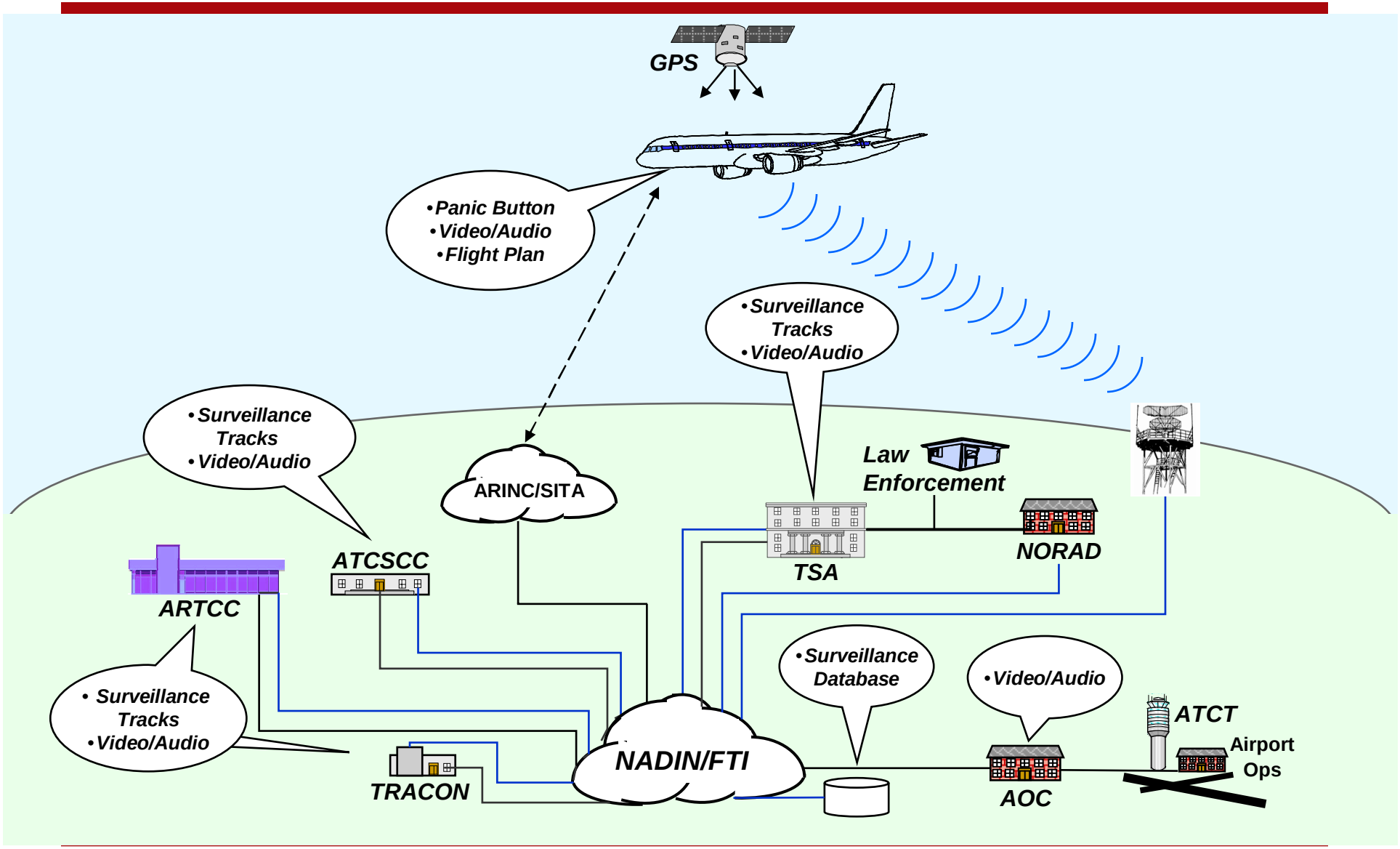
Scenario

- **Response team wants more information about highjackers and situation onboard the aircraft**
  - **Command sent via ACARS message to transmit video and audio from one of the cameras in the cockpit**
  - **Later commands sent to change to different cameras**
  - **Response team learns**
    - **6 highjackers onboard: 2 in cockpit and 4 in cabin**
    - **ACME's aircrew is still flying aircraft**

Scenario

- **FAA's primary and secondary surveillance radars are continually updating aircraft's location**
- **Response team wants to know highjackers' destination**
  - **Command sent to aircraft to transmit FMS flight plan**
  - **Shortly thereafter, aircraft transmits current flight plan**
  - **10 minutes later, aircraft automatically transmits revised flight plan**
  - **Flight plan indicates that aircraft will change course in 6 minutes and fly towards Washington, DC.**
- **Applications and communications concepts employed will not end the highjacking. However,**
  - **FAA, TSA, airline and military personnel will gain information about the highjackers and their intent**
  - **Response team will have more useful information with which to develop a plan of action**

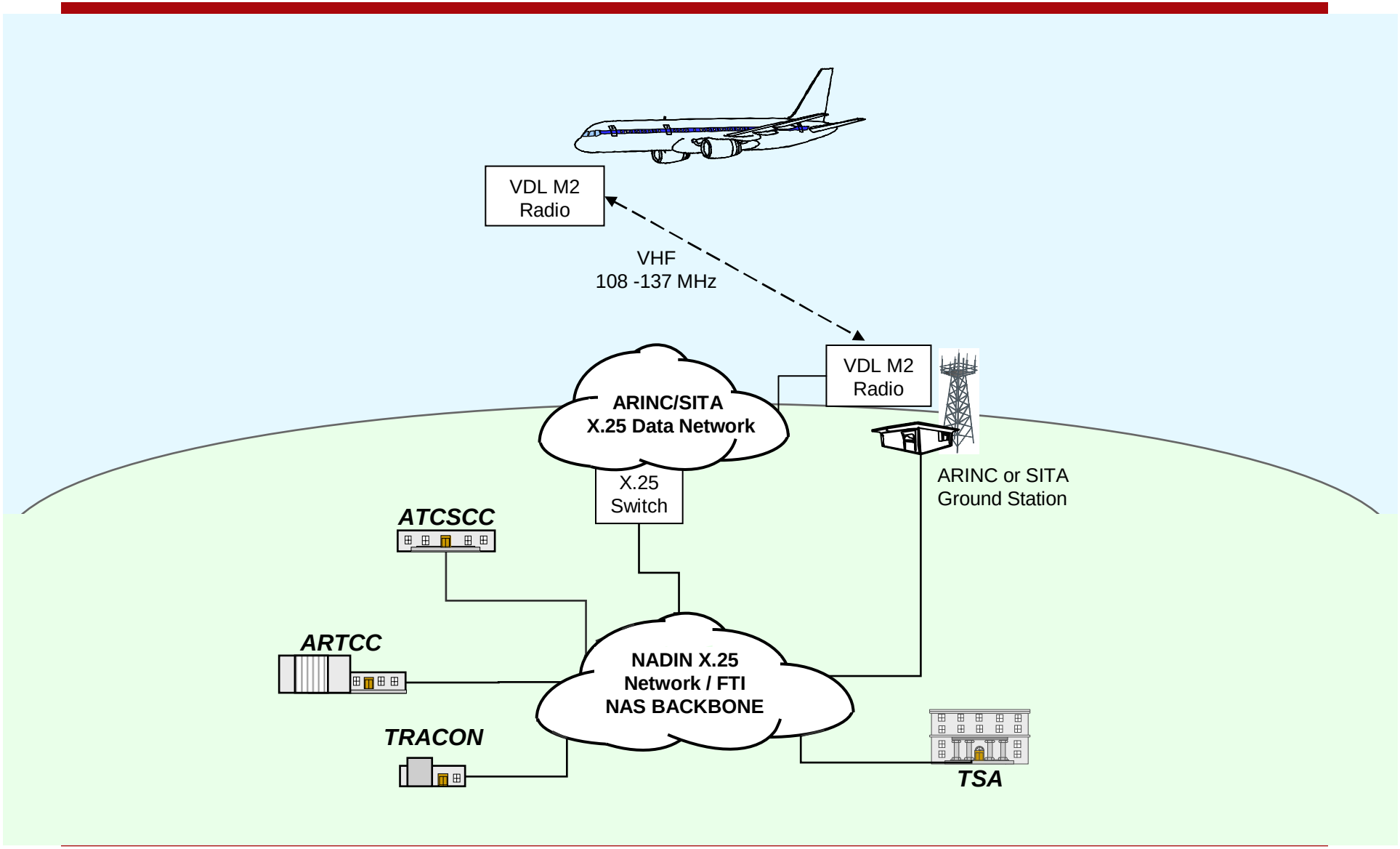
Communications Architecture



Communications Architecture

- **Uses existing applications and infrastructure to maximum extent reasonable**
  - **Least costly concepts are most likely to be accepted and funded => Implementation**
- **Datalink media is VDL Mode 2**
  - **Airlines have or will soon equip to support ACARS and ATN applications**
- **FAA ground network: NADIN II today and replaced by FTI as it comes online**
- **ARINC and SITA networks have NADIN II interfaces and will interface with FTI**
- **ARINC and SITA have existing ACARS systems used to exchange messages between aircraft, AOC, and FAA**

Aircraft/FAA & TSA Communications



Panic Button

- **Used by aircrew member to alert ATC, TSA and AOC of highjacking**
- **Scripted ACARS message created and transmitted**
  - **Contains flight information (ID, location, status, etc.)**
  - **Sent to the ATCSCC via VDL-2 radio and ground network**
    - **ATCSCC will have predetermined static address for these messages**
  - **Using ACARS message takes advantage of existing ARINC and SITA infrastructures with gateways into FAA's NADIN II network**
- **ATCSCC forwards message to TSA, AOC and ARTCC controlling aircraft**
- **Synthesized voice message on current VHF ATC frequency**
  - **"Highjack, Highjack, Highjack < aircraft tail number>"**

Panic Button

- **Technical Issues**
  - **Use of panic button type message was demonstrated by ARINC at NASA's Glenn Research Center in Jan 02**
  - **Automatically generating synthesized voice message over analog VHF radio occurs today (e.g., UNICOMM)**
- **Implementation, Feasibility, Scalability & Cost**
  - **Technology currently available for panic button generated ACARS message**
  - **No additional cost associated with transmission for ACARS equipped aircraft**
  - **Some cost associated with modifying ACARS software**
  - **Synthetic voice message from aircraft via VHF radio is low cost development effort**
  - **Datalink and voice concepts scale well**

Aircraft Video/Audio Surveillance

- **Video and audio on demand could be initiated by ground control center (either ATC or TSA) via ACARS message**
  - **Message specifies camera used for transmission**
    - **Surveillance system could include cameras in cabin, cockpit and cargo bays**
  - **Initiating message uses authentication and encryption techniques**
- **Pilot could initiate in response to a voice request from ATC**
- **Cameras are linked to video/audio system controller that formats as streaming video for transmission**
  - **Streaming video encrypted**
    - **Intercepted video shown on national TV could alert highjackers that they are being monitored**

Aircraft Video/Audio Surveillance

- **Video/audio controller interfaces through the CMU to VDL-2 radio**
- **If request initiated from ground, video sent to "from" address in ACARS message**
- **If pilot initiates, video sent to predetermined address at ATCSCC**
  - **ATCSCC distributes video to TSA and other organizations**

Aircraft Video/Audio Surveillance

- **Technology Issues**
  - **ARINC demonstrated technology for transmitting unencrypted video via VDL-2 from aircraft to ground station**
  - **Demonstration showed that quality of video carried over VDL-2 needs improvement**
    - **VDL-2 throughput constrains number of transmitted frames per second**
  - **Limited bandwidth results in transmission of images and sound from only one camera at a time**
  - **Effective authentication and encryption mechanisms needed**

Aircraft Video/Audio Surveillance

- **Implementation, Feasibility, Scalability & Cost**
  - **VDL-2 radio in daily use by ARINC, SITA, and airlines for business communications between aircraft and company operations**
  - **VDL-2 is ACARS and ATN compliant**
  - **Configuring video transmission application to use existing radio and ground network is cost-effective solution**
  - **Using VDL-2 as communications media has best chance of implementation**
  - **Scalable solution since it can be deployed on multiple aircraft once it is developed**

Remote Flight Plan Monitoring

- **Flight Management System (FMS) maintains current flight plan onboard an aircraft**
  - **Flight plan is represented by series of 3-D waypoints and times when aircraft should be at each waypoint**
- **Flight plan is entered prior to takeoff and can be modified by aircrew while airborne**
- **Communications architecture provides means to send aircraft's flight plan to ground control center**
- **When FAA/TSA/AOC highjack response team wants to know aircraft's intended flight path**
  - **Encrypted ACARS message sent via VDL-2 to aircraft's CMU**
  - **CMU authenticates that message came from FAA or TSA**
  - **CMU sends FMS an instruction to prepare message containing flight plan**
  - **Flight plan message prepared by FMS, encrypted by CMU and transmitted via VDL-2**

Remote Flight Plan Monitoring

- **Technology Issues**
  - **New ACARS messages would have to be developed to carry the flight plan request and response information**
  - **Currently, ACARS messages are not digitally authenticated or encrypted. Such techniques would have to be developed.**
- **Implementation, Feasibility, Scalability & Cost**
  - **ACARS and VDL-2 radio are currently operational in commercial aircraft**
  - **Adding authentication and encryption capabilities would add cost to system**
  - **Scalable solution since it can be deployed on multiple aircraft once it is developed**

Conclusion

- **Highjacking of commercial aircraft continues to be a potential threat to the United States**
- **Dealing effectively with highjackings requires**
  - **Early detection**
  - **Knowledge about the highjackers and what they are doing onboard the aircraft**
  - **Knowledge about aircraft's location and intended flight path**
- **Panic button, video/audio on demand, and flight plan transmissions concepts provide first responders in FAA, TSA and AOC with tools to more effectively deal with highjackings**

Contact

Tom Mulkerin
Mulkerin Associates Inc.
7405 Alban Station Ct., Suite B-201
Springfield, VA 22150-2318
(703) 644-5660
Tom.Mulkerin@Mulkerin.com